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*Research Article*

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# Validity of mobile learning-based practicum instructions with a guide inquiry approach to improve critical thinking skills

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**ABSTRACT**

Mobile learning-based practicum instructions to improve critical thinking have not been maximally empowered in schools. This study aims to design mobile learning-based practicum instructions with a guided inquiry approach to enhance critical thinking skills and describe the validity of mobile learning-based practicum instructions with a Guide Inquiry approach to improve critical thinking skills that have been designed. This research uses the Research and Development method with the ADDIE development model. The procedure of this research is analysis, design, and development. This research comes to the stage of product validity. The instrument used in this study is a validity sheet covering aspects of material, systematics, linguistics, and graphics. The data analysis technique used in this study is a quantitative descriptive technique to describe validation data and comment on validator advice. The results of this study show that mobile learning-based practicum instructions have met valid criteria with an average percentage of 84.95%. Thus, it can be concluded that the mobile learning-based practicum instructions with a guided inquiry approach improve critical thinking skills that are designed to be valid.

**Keywords:** Critical thinking; inquiry; mobile learning

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## INTRODUCTION

The development of science and technology in the 21st century has brought significant changes in various fields of human life, both in terms of culture, economy, and education. This causes the purpose of education to prepare human resources who can face future challenges effectively and efficiently. Learning activities are required to utilize all aspects of existing resources, including information and communication technology (ICT) or known as ICT (Information and Communication Technology (Tanwir et al., 2018). The American Association College of Teacher Education (AACTE), 2013) states that in the

21st century, educators must collaborate technology in learning. It can develop creativity and skills in using technology according to the required lessons' demands (Jogezai et al., 2018). The use of ICT is related to the packaging of technology-based learning media that can bring innovations and improve the quality of learning media (Juliana & Muslem, 2017). The use of technology in learning aims to provide a proactive teaching and learning environment and achieve higher understanding and learning outcomes (Ghavifekr & Rosdy, 2015; Sujanem, 2012).

Learning media is one of the keys to success in the learning process (Ulfah et al., 2016). The use of learning media can increase students' interest, motivation, and active interaction in the classroom. Learning media collaborated using technology can create more effective, interactive, exciting, and fun learning so that learning objectives can be easily achieved (Oktavianingtyas et al., 2018; Saniriati et al., 2021). Similar to what was stated by Hendraningrat & Fauziah (2021), digital learning media makes the delivery of learning materials more varied, not only verbally but can be in the form of text, video, visual and audio. Thus making it easier for students to understand and visualize learning materials can increase student interest, activity, and learning outcomes (Muid & Aziz, 2020). Learning media has a reasonably vital function in learning, so educators often use it in classroom learning for all subject matter and learning methods, one of which is the practicum method (Daud & Rahmadana, 2019).

Practicum is a learning method to develop concepts, providing opportunities for students to test and apply the results from the theory learned in everyday life (Maulidatul et al., 2019). Practicum activities require learning media to support practicum implementation, namely practicum instructions. Practicum instructions are learning media that present information in tools, materials, procedures, or work steps that make it easier for students and teachers to carry out practicum activities (Prayitno, 2017; Widyaningrum & Wijayanti, 2019). Practicum instructions are generally in the form of printed teaching materials that are less effective, practical, and efficient when used in practicum and are not following the development of the 21st era based on ICT (Hamidah et al., 2014; Mahrawi et al., 2022). With the increasingly sophisticated development of ICT, conventional practicum instructions require changes to improve quality by applying ICT, namely mobile learning-based practicum instructions.

One of the factors for the success of the learning process is no less important than learning media, namely the learning approach (Handhika, 2012). Accurately choosing a learning approach will make it easier to achieve the planned learning objectives (Rusyadi, 2021). In the 21st century, the learning objectives are to achieve 4C skills, one of which is critical thinking skills (Septikasari & Frasandy, 2018). Critical thinking skills are the ability of an individual to examine his own opinions, make generalizations by evaluating different facts, and interpret experiences experienced rationally (Nugrahaeni et al., 2017; Ratnasari & Cintamulya, 2021). Several factors can determine the success of forming critical thinking skills in the learning process, namely expertise in choosing the appropriate learning approach (Karim & Normaya, 2015; Nikmah & Cintamulya, 2017). Several learning approaches are suitable for improving critical thinking skills through the practicum method, one of which is the guide inquiry approach. The Guide Inquiry approach is a learning approach where students act as researchers who carry out scientific activities (Puspita et al., 2013). This will maximize students' ability to investigate, dig up information and formulate new ideas to solve problems systematically, critically, logically, and analytically using high-level thinking skills (Kurniawan, 2013). The same thing was also stated by Handayani (2017) and Indriwati et al. (2018) that the Guide Inquiry learning approach can improve the understanding of students' critical thinking concepts and skills implemented in Biology subjects.

Biology subjects, especially fern plant sub-materials, are materials that can be integrated with the use of local potential as a source of learning (Arital et al., 2018; Vitdiawati et al., 2016). Situmorang (2016)

stated that biology learning as a part of education has great potential in utilizing the environment as a learning resource. There are many local potentials, especially those in the Tuban district, which can be integrated into biology learning, one of which is the Bektiharjo natural bathing tourist attraction (Farnadayanti & Mustofa, 2021). Based on the observations, the tourist attraction located in Semanding district, Tuban regency, has an abundance of diversity of fern plant species, as many as seven species with 132 individual fern plants. With the abundance of diverse types of fern plants and comfortable environmental conditions for learning, it is very suitable to be implemented as a source and place to learn fern plant material in practicum instructions.

Many previous researchers have carried out research related to ICT-based practicum instructions. Research on developing electronic practicum guides based on temperature and heat material science process skills for junior high schools/ MTs using the Kvisoft Flipbook Maker application, which features videos, music, and experimental links, has been carried out by Ningsi et al., (2021). Research on developing green chemistry-based electronic practicum guides with a learning cycle-7e learning model on acid-base material designed on flip book maker applications, adobe flash cs6, and canva has also been carried out by Mulyanti et al., (2022). The same research has also been carried out by Pea et al., (2021), namely identifying cell morphology and bacterial types of Tambakrejo river water as a medium for electronic practicum guide designed using Microsoft Word then converted to pdf then through the Anyflip application formed into flipped learning. Oktaviani et al., (2020) also researched the development of an e-guide to the science practicum of guided inquiry-based living creature classification materials designed using the 3D PageFlip application. Based on the results of previous researchers' research, research on ICT-based practicum instructions was designed using the Articulate Storyline3 application by utilizing local potential as a learning resource for new research. Compared to mobile learning-based practicum instructions from previous research, which are usually in the form of pdf, power points, and flipbooks, the update of mobile learning-based practicum instructions in this study is in the form of an application made using the Articulate Storyline3 program. Another novelty of this study is that the author uses local potential in the form of tourist attractions as a source and place of learning as well as a Guided Inquiry approach to improve critical thinking skills.

Based on the background above, the author aims to design mobile learning-based practicum instructions with a Guide Inquiry approach to improve critical thinking skills and describe the validity of mobile learning-based practicum instructions with a Guide Inquiry approach to enhance critical thinking skills designed. The absence of previous research on mobile learning-based practicum instructions with a Guide Inquiry approach to improving skills about fern plant material is the author's goal to develop mobile learning-based practicum instructions with this Guide Inquiry approach. Mobile learning-based practicum instruction with the Guide Inquiry approach is expected to improve critical thinking skills and provide new learning experiences for students. These mobile learning-based practicum instructions will also likely help teachers explain fern plant material using attractive mobile learning-based learning media.

## RESEARCH METHODS

This research is development research to create a new product, namely mobile learning-based practicum instructions with a Guide Inquiry approach to improving students' critical thinking skills on fern plant material. This study uses the development model used in this study is the ADDIE development model. The ADDIE development model consists of 5 stages, namely Analysis, Design, Development, Implementation, and Evaluation (Dwitiyanti et al., 2020), as presented in Figure 1.

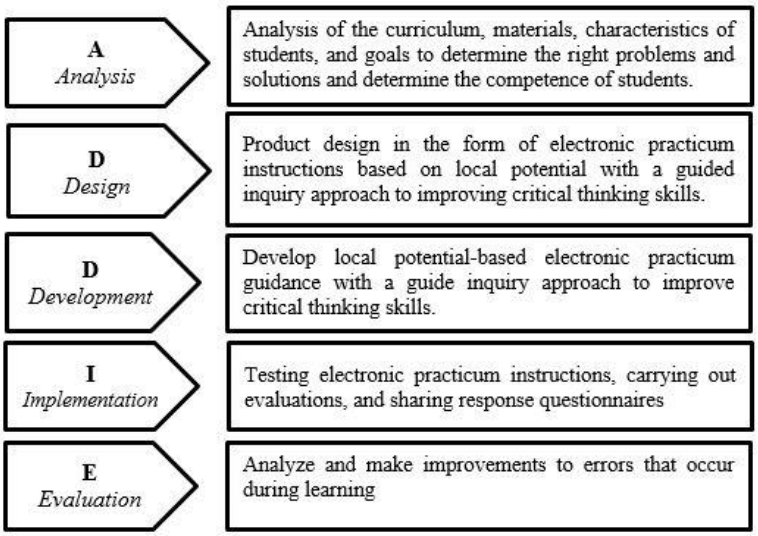


**Figure 1. ADDIE Development Research Procedure (Dwitiyanti et al., 2020)**

This research is limited to the third stage, namely development by conducting product validation tests. This research reached the third stage due to impossible conditions due to the Covid-19 pandemic, and students are still learning at home. Here are the steps of this research based on the ADDIE development model:

1. Stages of Analysis
   The analysis stage is used to analyze the needs of practicum instructions in the field and identify problems regarding practicum instructions that are obstacles in practicum activities by analyzing the curriculum that applies in schools, subjects, and student characteristics.
2. Design Stages (design)
   The design stage is the stage of starting to design a mobile learning-based practicum instruction product with a Guide Inquiry approach to improve critical thinking skills by collecting several references and things needed to support the preparation of mobile learning-based practicum instructions such as backgrounds, fern plant images, decoration icon images, and so on. Mobile learning-based practicum instructions with a Guide Inquiry approach to improving critical thinking skills using the Articulate Storyline3 application. At this stage, a validation sheet is also compiled, which will be used for validation assessment of mobile learning-based practicum instructions covering aspects of material, systematics, linguistics, and graphics.
3. Stages of Development (development)
   The development stage is the stage of realizing the product to be developed. After the product development is completed, the mobile learning-based practicum instructions will be validated by validators, namely biology subject teachers and biology lecturers. Validation is carried out to assess the quality of mobile learning-based practicum instructions against validity requirements, including material validity, systematics, grammar, and graphics.

Research on mobile learning-based practicum instructions with a Guide Inquiry approach on fern plant material was carried out for four months. Designing mobile learning-based practicum instructions with a Guide Inquiry approach on fern plant material was conducted on May 21 – June 28, 2022. Meanwhile, the implementation of the product validity assessment will be on July 18-25, 2022, and the analysis of research results and article preparation will be carried out on July 26 - August 8, 2022.

This research data was collected using validity instruments undergoing the instrument validation stage. Validation instruments that contain material, systematic, linguistic, and visual aspects. The material aspect validation instrument is decomposed into nine statements, systematics into twelve statements, linguistics into eight statements, and graphicality into fifteen statements. Validation sheets are used to obtain quantitative data in the form of product validation assessment scores and qualitative data in the form of validator comments and suggestions collected with product validation sheets carried out by validators. The data analysis technique used in this study is descriptive quantitative, which is used to describe the validity data of mobile learning-based practicum instructions with a Guide Inquiry approach to improving critical thinking skills by calculating all scores on validation sheets with Likert scale criteria referring to Janti (2014) seen the Table 1.

**Table 1. Likert Scale Score Criteria.**

| Score | Description |
|---|---|
| 5 | Very valid |
| 4 | Valid |
| 3 | Valid enough |
| 2 | Less valid |
| 1 | Invalid |

The entire value of each validation criterion from the validation of aspects of material, systematics, linguistics, and graphics is recapitulated with the number of respondents. Furthermore, the score that has been obtained from each criterion is divided by the maximum score of each criterion and multiplied by 100% (Figure 2).

$$\text{Validity} = \frac{Total\ Score\ Result}{Total\ Score\ Maximum} \times 100\%$$

**Figure 2. Validity Value Formula**

After obtaining the validity value of each criterion, the sum of validity percentages for all criteria will be averaged. Such average results are guidelines for assessing validity based on the scores obtained. The results of the percentage data obtained will be interpreted according to the validity criteria referred to by Arikunto (2013) (Table 2).

**Table 2. Validity Assessment Criteria**

| Percentage | Criteria |
|---|---|
| 90%-100% | Very valid |
| 75%-89% | Valid |
| 65%-74% | Valid enough |
| 40%-64% | Less valid |
| 0%-39% | Invalid |

## FINDING AND DISCUSSION

Research on the development of mobile learning-based practicum guidance with a Guide Inquiry approach to improve critical thinking skills using the 3 stages of the ADDIE developer model, namely Analysis, Design, and Development. The stages of analysis include the analysis of the curriculum, subjects, learning objectives, and student characteristics. The design stages have the selection of mobile learning applications, the choice of media formats, the preparation of materials, compiling the structure of practicum instructions, and assembling the design of practicum instructions. The stages of development include a test of the validity of the product.

Curriculum analysis is carried out to determine the Core Competencies, Basic Competencies, and Indicators based on the curriculum applied at SMA/ MA Tuban as a reference for developing mobile learning-based practicum instructions with a Guide Inquiry approach to improving critical thinking skills. The curriculum analysis found that the curriculum in Tuban High School/ Ma used the 2013 curriculum. The Core Competencies, Basic Competencies, and Indicators obtained from the 2013 curriculum syllabus are presented in Table 3.

**Table 3 Analysis of Core Competencies, Basic Competencies, and Indicators for The Fern Plant Sub-Material**

| Core Competencies | Basic Competencies | Indicators |
|---|---|---|
| KI.3 : Understand, apply, analyze factual, conceptual, procedural knowledge based on his curiosity about science, technology, art, culture, and humanities with insights into society, nationality, statehood, and civilization related to phenomena and events, as well as apply procedural knowledge to specific fields of study in accordance with his talents and interests to solve problems.<br>KI.4 : Processing, reasoning, and studying in the concrete and abstract realms related to the development of what he learned in school independently and using methods according to scientific principles. | 3.7 Grouping plants into divisions based on standard features and attributing their role in life processing, reasoning, and studying in the concrete and abstract realms related to developing what he learned in school independently and using methods according to scientific principles.<br>4.7 They presented data on the morphology and role of plants in various aspects of life in the form of written reports. | 3.7.1 Describing the morphological features of fern plants.<br>3.7.2 Classifying fern plants based on morphological features.<br>3.7.3 Identifying fern plants in the surrounding environment<br>3.7.4 Analyze the role of fern plants in everyday life<br>4.7.1 Compiling and presenting practicum reports on fern plants<br>4.7.2 Communicate the results of the practicum in the class and discuss it. |

The subject analysis is carried out after analyzing the curriculum to find out and detail the materials that will be contained in the practicum instructions. Based on the study of the subjects, the appropriate material will be applied to the mobile learning-based practicum instructions with a guide inquiry approach, namely the kingdom Plantae material of the fern plant sub-material. The fern plant material contained in the mobile learning-based practicum instructions was selected based on the results of observations on May 21, 2022 at one of the local potentials in Tuban regency, which will be used as a source and place for learning in this mobile learning-based practicum guide.

Learning objectives are analyzed to determine the learning objectives that students will achieve on plant material based on learning indicators. After the learning activities, students are expected to be able to describe the morphological characteristics of fern plants, classify fern plants based on morphological traits, identify fern plants in the surrounding environment, analyze the role of fern plants in daily life, compile and present practicum reports on fern plants, and communicate practicum results in class.

Student characteristics are analyzed to determine the characteristics of class X SMA students as a reference for choosing the right learning approach. Based on the observations of student characteristics, it was found that Class X SMA is a transitional class from junior high school to high school, so class X high school students still need teacher guidance in learning. Based on the analysis of student characteristics, the appropriate learning approach applied to local potential-based electronic practicum instructions for class X SMA students is the guide inquiry approach. In this learning approach, the teacher acts as a guide and facilitator.

The design stage aims to produce mobile learning-based practicum instructions with a Guide Inquiry approach to improving critical thinking skills. The steps to design mobile learning-based practicum

instructions with the Guide Inquiry approach are to analyze the curriculum, determine essential competencies and subjects, determine the title of practicum instructions, compile fern plant materials, compile fern plant catalogs, compile the structure of mobile learning-based practicum instructions, compile a mobile learning-based practicum instruction design in the articulate storyline3 application. The display of mobile learning-based practicum instructions can be seen in Figure 3. The main menu display on mobile learning-based practicum instructions be seen in Figure 4. The introductory slide view on mobile learning-based practicum instructions presented as in Figure 5. The slide view of learning steps guide inquiry on mobile learning-based practicum instructions can be seen in Figure 6. The fern plant catalog slide view on mobile learning-based practicum instructions presented as in Figure 7. The information slide view in mobile learning-based practicum instructions reflected in Figure 8.


**Figure 3. Title Display of Mobile Learning-Based Practicum Instructions**


**Figure 4. Main Menu Display on Mobile Learning-Based Practicum Instructions**


**Figure 5. Introductory Slide View on Mobile Learning-Based Practicum Instructions**


**Figure 6. Slide View of Learning Steps Guide Inquiry on Mobile Learning-Based Practicum Instructions**


**Figure 7. Fern Plant Catalog Slide View on Mobile Learning-Based Practicum Instructions**

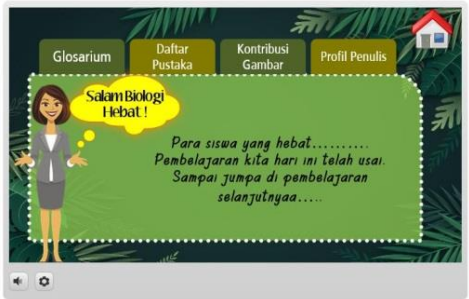


**Figure 8. Information Slide View in Mobile Learning-Based Practicum Instructions**

The display of several slides of mobile learning-based practicum instructions above is the final design of the mobile learning-based practicum instructions that have been improved based on comments and suggestions provided by validators. This mobile learning-based practicum instruction is designed using the Articulate Storyline3 application. Articulate Storyline3 is an application to design interactive learning media that can present text, audio, video, animation, and others (Indriani et al., 2021). This mobile learning-based practicum instruction has several components consisting of 1) Title; 2) The main menu

slide consists of an introduction menu, learning steps, a catalog of fern plants and information; 3) Introductory slides containing core competencies, essential competencies, indicators, learning objectives and practicum rules; 4) Slide learning steps with a Guide Inquiry approach which consists of six stages, namely identifying problems, formulating hypotheses, designing experiments, conducting experiments, analyzing data, and communicating conclusions; 5) Slides of fern plant material contained in the slide of the step of learning stages identify problems containing material on the introduction of kingdom Plantae, kingdom Plantae charts, definitions of fern plants, the body structure of fern plants, reproduction of fern plants, pictures of the stages of metagenesis of fern plants and grouping of fern plants; 6) The fern plant catalog slide contains a brief description of the morphological features, drawings and scientific classification of some species of fern plants; 7) Information slides contain glossaries, bibliography, image contributions, and author profiles. This mobile learning-based practicum instruction is also equipped with several navigation buttons: the following button, previous button, close button, gray home (back to the main menu) button, and orange colored home (back to the initial slide) button. The use of images and background colors that complement the appearance of mobile learning-based practicum instructions is adjusted to the material presented and uses the right colors to be balanced and harmonious to attract students to learn (Pranita et al., 2016).

The validation data for mobile learning-based practicum instructions were obtained from the validation assessment of mobile learning-based practicum instruction products conducted by three validators on July 18 and 25, 2022, at Universitas PGRI Ronggolawe and MA Al–Ma'arif Cumpleng. The validator here in question is a biology teacher. According to Ikhtiarni et al., (2021), biology teacher validators are responsible for checking the suitability of the material, language, systematics, and graphics of a product. Biology teachers are assumed to understand the material, systematics, language, and graphics in practicum instructions, so they are considered suitable as validators of this mobile learning-based practicum instruction Assessment of the validity of mobile learning-based practicum instructions is carried out based on the achievement of material, systematics, linguistics, and graphics aspects. Validators also provide comments and suggestions that are used as a basis for improving mobile learning-based practicum instructions. The results of the recapitulation of material validation, systematics, linguistic, and graphic tests by validators can be shown in Table 4. the following:

**Table 4. Recapitulation of User Validation Results by Teachers and Lecturers of Biology**

| No | Assessment Aspects | Validator Score | | | Average | Criterion |
|---|---|---|---|---|---|---|
| | | Validator I | Validator II | Validator III | | |
| 1 | Material criteria | 84% | 87% | 89% | 86.7% | Valid |
| 2 | Systematic criteria | 82% | 90% | 85% | 85.7% | Valid |
| 3 | Linguistic criteria | 80% | 85% | 90% | 85 % | Valid |
| 4 | Graphic criteria | 79% | 83% | 85% | 82.4% | Valid |
| **Average Percentage of Score Criteria** | | | | | **84.95%** | **Valid** |

Table 4 above shows that the validity assessment results are reviewed from the material, systematic, linguistic, and visual aspects of three validators. The material aspects of the mobile learning-based practicum instructions obtained valid categories with an average total percentage of 86.7%. This shows that the material, learning steps, and practicum steps contained in the mobile learning-based practicum instructions follow the core competencies, essential competencies, indicators, learning objectives, and syntax of the learning approach used. The results of material validation are concrete evidence that shows that the material presented is appropriately used in practicum activities so that learning objectives can be achieved (Fajarianingtyas & Hidayat, 2019). The total average score of the percentage of validation of systematic aspects in mobile learning-based practicum instructions was

85.7%, with valid categories. This result can be stated that the systematics of the mobile learning-based practicum instruction following the title of the practicum instruction, essential competencies, indicators, learning objectives, class level, semester, steps of the Guide Inquiry learning approach, and the collapse of the material arrangement following the fern plant material (Anggraini, 2016; Rusmana et al., 2019). The learning steps with the Guide Inquiry approach used in the mobile learning-based practicum instruction are systematically arranged following the syntax of the Guide Inquiry approach and sequence so that students can easily understand and carry out practicum activities (Chan & Budiono, 2019; Ramadhani & Fitri, 2020).

The linguistic aspect of mobile learning-based practicum instructions obtained a valid category with an average total percentage of 85%. From the results of language validation, it shows that the language used in the mobile learning-based practicum instructions follows the enhanced spelling (EYD), and the sentence preparation used is clear, unambiguous, effective, efficient, and follows the intellectual development of students, the language used arouses student learning motivation when reading it, the writing of the correct scientific name and the sentence used represents the content of the image or information to be conveyed by keep following the Indonesian grammar. This follows what Prayitno (2017) that the use of language in learning media must be by the correct Indonesian rules, clear language, communicative, simple, and unambiguous so that students can easily understand the content of the learning media. Saniriati et al., (2021) the results of linguistic validation show that the language used in learning media is by the correct Indonesian language rules and on student intellectual development.

The Graphic Aspect of mobile learning-based practicum instructions received an average validation percentage of 82.4% with valid categories. The results of this graphic validation test show that the graphics in the mobile learning-based practicum instructions display have a good proportion of layout, image quality, and a good combination of background color compositions, to the statement of Renita and Fauziah (2020) that the attractiveness of a learning media lies in the design of the appearance of the media. The same thing was also stated by Budiarti et al., (2016) that the selection of background colors, images, and icons supporting the design of the appearance of learning media must be harmonious. Based on the test results, the validity of material aspects, systematics, language, and graphics in the general mobile learning-based practicum instructions can be declared valid. However, because they have not yet achieved practicality and effectiveness in their use, the mobile learning-based practicum instructions with the Guide Inquiry approach to improving critical thinking skills developed cannot be said to be feasible for use in biology learning in the classroom.

## CONCLUSION

Based on the results of this study, it can be concluded that mobile learning-based practicum instructions have been designed with the articulate stroyline3 application, and mobile learning-based practicum instructions with a Guide Inquiry approach to improving critical thinking skills are valid. Mobile learning-based practicum instructions with a Guide Inquiry approach are expected to enhance critical thinking skills, increase learning motivation and provide new experiences for students, and can help teachers in explaining nail plant material. Mobile learning-based practicum instructions with a Guide Inquiry approach to improving critical thinking skills that are developed need to be followed up to the practicality and effectiveness test stage so that these mobile learning-based practicum instructions are suitable for use in learning.

## REFERENCES

The American Association College of Teacher Education AACTE & P21. (2013). Teachers for the 21st century. *Education*, *September*, 22–29. http://www.oecd-ilibrary.org/education/teachers-for-the-21st-century_9789264193864-en

Anggraini, A. (2016). Pengembangan petunjuk praktikum biologi pada materi jamur dengan pola pemberdayaan berpikir melalui pertanyaan (studi kasus di kelas X.3 SMA Muhammadiyah 1 Metrotahun Pelajaran (2013/2014). *BIOEDUKASI (Jurnal Pendidikan Biologi)*, *7*(1), 73–80. https://doi.org/10.24127/bioedukasi.v7i1.494

Arikunto, S. (2013). *Prosedur penelitian suatu pendekatan praktik*. Jakarta: Rineka Cipta.

Arital, S., Kamal, S., & Agustina, E. (2018). Keanekaragaman gastropoda di danau lut tawar Kabupaten Aceh Tengah. *Prosiding Seminar Nasional*, *ISBN: 978-*, 402–408. https://jurnal.ar-raniry.ac.id/index.php/PBiotik/article/view/4277/2814

Renita, E., S., A., & Fauziah, N., P., A. (2020). Pengembangan ensiklopedia tumbuhan paku sebagai sumber belajar keanekaragaman hayati. *Jurnal Biologi Dan Pembelajarannya (JB&P)*, *7*(1), 1–6. https://doi.org/10.29407/jbp.v7i1.14797

Budiarti, S., Nuswowati, M., & Cahyono, E. (2016). Guided inquiry berbantuan e-modul untuk meningkatkan keterampilan berpikir kritis. *Journal of Innovative Science Education*, *1*(1), 1–9. http://journal.unnes.ac.id/sju/index.php/jise

Chan, F., & Budiono, H. (2019). Pengembangan buku petunjuk praktikum IPA berbasis learning cycle bagi siswa kelas IV sekolah dasar. *Jurnal Gentala Pendidikan Dasar*, *4*(2), 166–175. https://doi.org/10.22437/gentala.v4i2.7919

Daud, F., & Rahmadana, A. (2019). Pengembangan media pembelajaran biologi berbasis e-learning pada materi ekskresi kelas XI IPA 3 SMAN 4 Makassar. *Jurnal Bionature*, *16*(1), 28–36. https://ojs.unm.ac.id/bionature/article/view/1566/630

Dwitiyanti, N., Kumala, S. A., & Widiyatun, F. (2020). Using the ADDIE model in development of physics unit convertion application based on Android as learning media. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *10*(2), 125–132. https://doi.org/10.30998/formatif.v10i2.5933

Fajarianingtyas, D. A., & Hidayat, J. N. (2019). Validitas buku petunjuk praktikum biologi dasar berbasis pemecahan masalah untuk mahasiswa pendidikan IPA di Universitas Wiraraja. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *9*(2), 37–45. https://doi.org/10.24929/lensa.v9i2.67

Farnadayanti, Y. S., & Mustofa. (2021). Mitos pemandian di Desa Bektiharjo dan Petilasan Sunan Kalijaga di Desa Medalem Kabupaten Tuban (kajian fungsi, nilai, dan resepsi masyarakat). *EDU-KATA : Jurnal Bahasa, Sastra Dan Pembelajarannya.*, *Vol 7 No 2 (2021): Agustus 2021*, 143–155. https://doi.org/https://doi.org/10.52166/kata.v7i2.2722

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science*, *1*(2), 175–191. https://doi.org/10.21890/ijres.23596

Hamidah, A., Sari, E. N., & Budianingsih, R. S. (2014). Persepsi siswa tentang kegiatan praktikum biologi di laboratorium SMA Negeri Se-Kota Jambi. *Jurnal Sainmatika*, *8*(1), 49–59. https://www.neliti.com/publications/221111/persepsi-siswa-tentang-kegiatan-praktikum-biologi-di-laboratorium-sma-negeri-se

Handayani. (2017). Penerapan metode guided inquiry dalam meningkatkan motivasi dan hasil belajar siswa pada mata pelajaran biologi. *Syntax Literate : Jurnal Ilmiah Indonesia*, *2*(11), 111. https://www.jurnal.syntaxliterate.co.id/index.php/syntax-literate/article/view/258

Handhika, J. (2012). Efektivitas media pembelajaran im3 ditinjau dari motivasi belajar. *Jurnal Pendidikan IPA Indonesia*, *1*(2), 109–114. https://doi.org/10.15294/jpii.v1i2.2127

Hendraningrat, D., & Fauziah, P. (2021). Media pembelajaran digital untuk stimulasi motorik halus anak usia dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(1), 58–72. https://doi.org/10.31004/obsesi.v6i1.1205

Ikhtiarni, F., Ardi, A., & Darussyamsu, R. (2021). Validity of ESQ booklets about structure and function of

animal tissue as biology learning supplement. *Edubiotik : Jurnal Pendidikan, Biologi Dan Terapan*, *6*(01), 26–39. https://doi.org/10.33503/ebio.v6i01.1223

Indriani, S. M., Artika, W. I., & Ningtias, W. R. D. (2021). Penggunaan aplikasi articulate storyline dalam pembelajaran mandiri teks negosiasi. *Jurnal Pendidikan Bahasa Dan Sastra Indonesia*, *11*(1), 25–36. https://doi.org/10.23887/jjpbs.v11i1.29316

Indriwati, S. E., Susilo, H., & Anggrela, D. P. (2018). Penerapan model pembelajaran inkuiri terbimbing berbasis lesson studypada matakuliah keanekaragaman hewan untuk meningkatkan kecakapan komunikasi dan hasil belajar kognitif mahasiswa pendidikan biologi. *Jurnal Pendidikan Biologi*, *09*(02), 38–46. http://journal2.um.ac.id/index.php/jpb

Janti, S. (2014). Analisis validitas dan reliabilitas dengan skala likert terhadap pengembangan SI/TI dalam penentuan pengambilan keputusan penerapan strategic planning pada industri garmen. *Prosiding Seminar Nasional Aplikasi Sains & Teknologi (SNAST)*, *November*, 211–216. https://journal.akprind.ac.id/index.php/snast/article/view/3493

Jogezai, N. A., Ismail, S. A. M. M., & Baloch, F. A. (2018). Secondary school teachers' concerns about ICT integration: Perspectives from a developing part of the globe. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(12). https://doi.org/10.29333/ejmste/95124

Juliana, R., & Muslem, A. (2017). The use of information and communication technology (ICT) amongst Efl teachers: Perceptions and challenges. *English Education Journal*, *8*(4), 469–487. https://jurnal.unsyiah.ac.id/EEJ/article/view/9211/7220

Karim, K., & Normaya, N. (2015). Kemampuan berpikir kritis siswa dalam pembelajaran dalam pembelajaran matematika dengan menggunakan model Jucama di sekolah menengah pertama. *EDU-MAT: Jurnal Pendidikan Matematika*, *3*(1). https://doi.org/10.20527/edumat.v3i1.634

Kurniawan, A. D. (2013). Metode inkuiri terbimbing dalam pembuatan media pembelajaran biologi untuk meningkatkan pemahaman konsep dan kreativitas siswa SMP. *Jurnal Pendidikan IPA Indonesia*, *2*(1), 8–11. https://doi.org/10.15294/jpii.v2i1.2503

Mahrawi, M., Rifqiawati, I., & Mulyani, D. (2022). Pengembangan panduan praktikum biologi pada konsep sistem pencernaan untuk mengembangkan keterampilan berpikir kritis. *Jurnal of Nusantara Education*, *1*(2), 68–78. https://doi.org/10.57176/jn.v1i2.11

Maulidatul, H. A., Ismail, & Mukhlishoh, S. S. (2019). Pengembangan modul biologi benilai islami materi sistem reproduksi pada manusia. *Bioeduca : Journal of Biology Education*, *1*(65), 18–28. https://doi.org/10.21580/bioeduca.v1i1.4951

Muid, A., & Aziz, M. (2020). *Inovasi pembelajaran berbasis ICT di MTS Manbaul Ihsan Mojopurogede Kecamatan Bungah Kabupaten Gresik*. 1–54. https://jurnal.maziyatulilmi.com/index.php/jippi/article/view/39/78

Mulyanti, S., Pratiwi, R., & Mardliyah, A. (2022). Penuntun praktikum elektronik berbasis green chemistry dengan model pembelajaran learning cycle-7e pada materi asam-basa. *Orbital: Jurnal Pendidikan Kimia*, *6*(1). https://ummaspul.e-journal.id/maspuljr/article/view/1159

Nikmah, I. N., & Cintamulya, I. (2017). Analisis berfikir kritis siswa yang bergaya kognitif reflektif dan implusif pada pembelajaran biologi melalui model problem base learning (PBL) dengan media puzzle analysis of critical thinking of cognitive stylistic students reflective and implusive on. *Proceeding Biology Education Conference*, *14*, 551–555. https://jurnal.uns.ac.id/prosbi/article/download/21098/16384

Ningsi, A. P., Purwaningsih, S., & ... (2021). Pengembangan penuntun praktikum ekektronik berbasis keterampilan proses sains materi suhu dan kalor untuk SMP/MTs. *Edumaspul 5*(1), 242–251. https://ummaspul.e-journal.id/maspuljr/article/view/1159

Nugrahaeni, A., Wayan Redhana, I., & Made Arya Kartawan, I. (2017). Penerapan model pembelajaran discovery learning untuk meningkatkan kemampuan berpikir kritis dan hasil belajar kimia. *Jurnal Pendidikan Kimia Indonesia*, *1*(1), 23–29. https://doi.org/10.23887/jpk.v1i1.12808

Oktaviani, R., M, D., & Muhaimin. (2020). Pengembangan e-penuntun praktikum ipa materi klasifikasi makhluk hidup berbasis guided inquiry untuk siswa kelas VII SMP. *Edu-Sains*, *9*(2). https://online-

journal.unja.ac.id/edusains/article/view/16970

Oktavianingtyas, E., Salama, F. S., Fatahillah, A., Monalisa, L. A., & Setiawan, T. B. (2018). Development 3D animated story as interactive learning media with lectora inspire and plotagon on direct and inverse proportion subject. *Journal of Physics: Conference Series*, *1108*(1). https://doi.org/10.1088/1742-6596/1108/1/012111

Pea, O., Meishanti, Y., & Ami, M. S. (2021). *Identifikasi morfologi sel dan tipe bakteri air sungai Tambakrejo sebagai media panduan praktikum elektronik*. *07*(01), 67–74. https://doi.org/10.32764/eduscope.v7i1.2067

Pranita, H. S., Mahanal, S., & Sari, M. S. (2016). Inventarisasi tumbuhan paku kelas Filicinae di Kawasan Wati Ondo sebagai media belajar mahasiswa. *Seminar Nasional Pendidikan Dan Saintek 2016*, *2016*, 733–740. https://publikasiilmiah.ums.ac.id/handle/11617/8007

Prayitno, T. A. (2017). Pengembangan petunjuk praktikum mikrobiologi program studi pendidikan biologi. *Biota*, *3*(1), 31. https://doi.org/10.19109/biota.v3i1.1041

Ramadhani, R., & Fitri, Y. (2020). Validitas e-modul matematika berbasis EPUB3 menggunakan analisis rasch model. *Jurnal Gantang*, *5*(2), 95–111. https://doi.org/10.31629/jg.v5i2.2535

Ratnasari, S., & Cintamulya, I. (2021). *Validitas petunjuk praktikum elektronik untuk meningkatkan kemampuan berpikir kritis siswa melalui problem based learning*. *6*(1), 579–585. http://prosiding.unirow.ac.id/index.php/SNasPPM/article/view/568

Rusmana, J., Ramdiah, S., & Prayitno, B. (2019). Pengembangan booklet sebagai sumber belajar biologi melalui nilai-nilai kearifan lokal dalam pembuatan bakul purun. *Prosiding Seminar Nasional Lingkungan Lahan Basah*, *4*(3), 603–607. https://snllb.ulm.ac.id/prosiding/index.php/ snllb-lit/article/view/254

Rusyadi, A. (2021). Pembelajaran IPA berbasis inkuiri terbimbing. *Prosiding Magister Pendidikan Ilmu Pengetahuan*, 61–66. http://jbse.ulm.ac.id/index.php/PMPIPA/article/view/25

Saniriati, D. M. D., Dafik, D., & Murtikusuma, R. P. (2021). Pengembangan media pembelajaran adobe animate berbantuan schoology pada materi barisan dan deret aritmetika. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, *4*(2), 132. https://doi.org/10.26740/jrpipm.v4n2.p132-145

Septikasari, R., & Frasandy, R. N. (2018). Keterampilan 4C abad 21 dalam pembelajaran pendidikan dasar. *Tarbiyah Al-Awlad*, *VIII*(2), 112–122. https://doi.org/10.15548/alawlad.v8i2.1597

Situmorang, R. P. (2016). Analisis potensi lokal untuk mengembangkan bahan ajar biologi di SMA Negeri 2 Wonosari. *Jurnal Pendidikan Sains Universitas Muhammadiyah Semarang*, *4*(1), 51–57. https://doi.org/10.26714/jps.4.1.2016.51-57

Sujanem, R. (2012). Pengembangan modul fisika kontekstual interaktif berbasis web untuk meningkatkan pemahaman konsep dan hasil belajar fisika siswa SMA di Singaraja. *Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI)*, *1*(2), 103. https://doi.org/10.23887/ janapati.v1i2.9825

Tanwir, T., Rahman F, A., & Rahman F, A. (2018). Dampak penggunaan media pembelajaran berbasis ICT terhadap hasil belajar PAI peserta didik pada SMK Negeri 1 Kota Parepare. *AL-ISHLAH: Jurnal Pendidikan Islam*, *16*(1), 11–36. https://doi.org/10.35905/alishlah.v16i1.732

Puspita, A., T., Jatmiko, B., Fisika, J., Matematika, F., Ilmu, D., & Alam, P. (2013). Implementasi model pembelajaran inkuiri terbimbing (guided inquiry) terhadap keterampilan berpikir kritis Siswa pada pembelajaran fisika materi fluida statis kelas XI di SMA Negeri 2 Sidoarjo. *Jurnal Inovasi Pendidikan Fisika*, *02*(03), 121–125. https://doi.org/10.26740/ipf.v2n3.p%25p

Ulfah, T. A., Wahyuni, E. A., & Nurtamam, M. E. (2016). Pengembangan media pembelajaran permainan kartu uno pada pembelajaran matematika materi satuan panjang. *Prosiding Seminar Nasional Matematika Dan Pembelajarannya. Jurusan Matematika, FMIPA UM.*, *3*(3), 955–961. https://osf.io/qt4mv/

Vitdiawati, R., Nusantari, R., & Tyas, D. N. (2016). Pengembangan petunjuk praktikum berbasis geopark dengan pendekatan inquiry learning untuk mata kuliah ekologi. *Universitas Ahmad Dahlan*, 301–310. http://symbion.pbio.uad.ac.id/prosiding/prosiding/ID_310-Rina%20Vitdiawati-

Revisi_Hal%20301-310.pdf

Widyaningrum, D. A., & Wijayanti, T. (2019). Implementasi buku petunjuk praktikum biokimia berbasis inkuiri terbimbing untuk meningkatkan kemampuan kerja ilmiah. *Edubiotik : Jurnal Pendidikan, Biologi Dan Terapan*, *4*(02), 58–67. https://doi.org/10.33503/ebio.v4i02.437